Economic
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Foreign
Agricultural
Economic Report
Number 219

Policymaking for U.S. Commodity Programs:

A Case Study of the Coarse Grains Sector

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Policymaking for U.S. Commodity Programs: A Case Study of the Coarse Grains Sector, by Praveen M. Dixit and Marshall A. Martin, International Economics Division, Economic Research Service, U.S. Department of Agriculture. Foreign Agricultural Economic Report Number 219.

Abstract

The authors used an econometric model of the U.S. coarse grains sector to demonstrate the extent to which commodity program loan rates and price support levels are based on market forces. Their analysis shows that policy is changed cautiously in response to short-term shifts in the economic environment but that the response is likely to be quicker when the shifts originate in the domestic market than in the export market. The authors' results also indicate that a moving average method of determining loan rates would lead to lower domestic and world market prices and provide greater shortrun stability to the U.S. agricultural sector.

Keywords: Coarse grains sector, corn, price supports, loan rates, domestic markets, export markets.

Acknowledgments

Phil Abbott, Jim Binkley, Jim Langley, and Jerry Sharples for review comments; Lindsay Mann for editorial assistance; Kathy Bybee and Dorothy Maddox for manuscript preparation.

Washington, DC 20005-4788 May 1986

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Summary

The authors used an econometric model of the U.S. coarse grains sector to demonstrate the extent to which commodity program loan rates and price support levels are based on market forces. Their analysis shows that policy is changed cautiously in response to short-term shifts in the economic environment but that the response is likely to be quicker when the shifts originate in the domestic market than in the export market. The authors' results also indicate that a moving average method of determining loan rates would lower domestic and world market prices and provide greater shortrun stability to the U.S. agricultural sector.

By extending the applications of earlier modeling efforts, the authors arrived at the following conclusions:

- Major changes in domestic production can dramatically alter the environment in which policy decisions are made. A major production shortfall or a bumper crop can affect Government policy decisions for nearly 5 years, even though the entire domestic supply-and-demand structure returns to equilibrium within 3 years.

- Extreme changes in the export market economy are necessary to bring about changes in Government programs. This predicament may reflect a belief that the political costs of not responding to external changes are lower than for similar domestic changes.

- The costs of programs intended to stabilize commodity production should be examined carefully. Some farmers participating in Government programs may be high cost producers who are enrolling marginal land in land diversion programs. Therefore, current policies may be inadvertently encouraging misallocation of resources.

- Although limiting total stocks of the Farmer-Owned Reserve may solve problems associated with large accumulation of Government-owned grain stocks, a ceiling on the reserve could mean lower market prices and larger price support payments. Lower stocks would also mean the Government would have less leverage to influence overall market prices.

- A moving average method for setting loan rates should provide definitive, timely information for establishing those rates, lower domestic and world agricultural prices, and provide greater shortrun stability.

The authors based their recommendations on Government behavior which existed between 1960 and 1981. Because Government, in particular, and the overall economy, in general, may change dramatically in the future, these recommendations and conclusions are valid only for conditions similar to those experienced during the decades of the the sixties and seventies.

Note:

This report uses metric units throughout:

1 metric ton = 2,204.62 pounds
1 hectare = 2.471 acres

Policymaking for U.S. Commodity Programs: A Case Study of the Coarse Grains Sector

Praveen M. Dixit and Marshall A. Martin*

Introduction

Government programs have greatly influenced U.S. agriculture since the early thirties when low farm incomes and depressed prices led to the passage of the Agricultural Adjustment Act of 1933. Since then, Congress has passed a variety of agricultural laws aimed primarily at enhancing the income of the farm populace and stabilizing agricultural prices. These laws have covered many agricultural commodities, but they have focused on a few basic commodities, including wheat, coarse grains, cotton, peanuts, and tobacco.[1]

Most agricultural legislation has focused on domestic price support programs. As Bowers, Rasmussen, and Baker point out, the programs themselves have changed comparatively little during the past 50 years (*2*). Loan rates and support payments (target prices), accompanied by some form of acreage reduction, paid land diversion, and Government stockpiling provisions, appear in most major agricultural laws. New program features as such have been few and far between. Consequently, most farm-related laws have had two major objectives: they should balance supply and demand at acceptable price levels and they should support farm income. At the same time, legislators have sought to keep Government expenditures under control. This recurring theme was apparent in the debate over the 1985 farm bill. During the debate, Government leaders, farmers, and various interest groups concentrated largely on the levels at which the Government should establish the historic policy instruments.

Embodied in these debates over the levels of policy instruments is the implicit issue of how agricultural legislation is formulated. Does the Government establish the levels of policy instruments based solely on economic variables that influence the agricultural sector, or is the process largely random, dependent mostly on political considerations? How does the Government interact with the private sector in formulating agricultural legislation? What are the roles of the interest groups in policy formulation? To what extent do budget considerations influence the levels of the policy instruments?

This report addresses these and related questions concerning the legislative process. We have attempted to explain, analyze, and predict factors that influence and determine Government behavior. In particular, we have addressed two issues. First, the study identifies factors that influence the levels at which the Government establishes policy instruments such as support prices, loan rates, and diversion payment rates. This identification process requires an understanding of the behavior of interest groups affected by the various policy instruments and an examination of the interactions between the private and public sectors in the process of policy formulation. Second, the report illustrates how an econometric model that incorporates endogenous policy and quasi-policy variables can be used to analyze potential Government responses to changes in the economic environment. This study therefore involves a conceptual extension of earlier modeling efforts by Rausser and Freebairn (*11*), Abbott (*1*), Lattimore and Schuh (*8*), Paarlberg (*10*), and Meilke and Griffith (*9*).

We selected the U.S. coarse grains market to study the process of policy formulation for four principal reasons. First, the coarse grains market is an extremely important component of the U.S. agricultural sector. In 1984, cash receipts from coarse grains sales represented approximately 12 percent of total agricultural marketing receipts. Second, coarse grains account for a large proportion of Government program payments. Between 1960 and 1980, coarse grains payments amounted to nearly a third of all support payments during the same period. Third, basic U.S. coarse grains policies over the last five decades have been fairly stable in their orientation (*2, 5*). This stability simplifies selection of a few

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[1]Tweeten (*13*), Cochrane and Ryan (*4*), and Bowers, Rasmussen, and Baker (*2*) provide comprehensive descriptions of farm legislation dating back to the twenties and examine how these laws and programs have been modified for changing economic situations in the past half century. Italicized numbers in parentheses identify literature listed in the References at the end of this report.

policy and quasi-policy variables for modeling purposes. We can then concentrate on how the levels of and changes in these policy and quasi-policy variables are determined. Finally, coarse grains policies are similar to policies for other commodities, such as cotton and wheat; understanding the legislative process for coarse grains may provide insights into Government behavior concerning other commodities as well.

Specifying the Model

The coarse grains model we developed for this study consists of 33 equations which describe the corn market and an aggregated other coarse grains market (*5, 6*). These equations are further classified into a number of functional "blocks" (table 1). Each block incorporates equations that are directly relevant to either the supply of the commodity, the domestic demand for the commodity, the Government policy instruments applicable to the commodity, or external trade. The corn sector contains supply, demand, and policy blocks. The other coarse grains sector has supply and demand blocks only. Given the similarities in policies between corn and other coarse grains, corn policy variables are used as proxies for the other coarse grains sector. The trade block establishes the linkage between the corn and the other coarse grains sectors and also reflects their export behavior.

Table 1—Conceptual model for the coarse grains market

Supply block equations
- Area planted by farmers participating in Government programs
- Area planted by farmers outside Government programs
- Area set aside by farmers participating in Government programs
- Total area planted
- Total area harvested
- Total output

Demand block equations
- Food demand
- Feed demand
- Nonrecourse loan stocks demand
- Commodity Credit Corporation-owned stocks demand
- Farmer-held "free" stocks demand
- Total stocks demand
- Total domestic demand

Policy block equations
- Effective support price for corn
- Effective diversion payment rate for corn
- Loan rate for corn

Trade block equations
- World coarse grains import demand
- Corn exports of other exporters
- Other coarse grains exports of other exporters
- Other coarse grains exports of the United States
- Corn exports of the United States

Market clearing identity
- U.S. average farm price of corn

The supply block, based on a two-stage maximization process, includes six equations for each sector. In the first stage, farmers determine area planted under Government programs, area planted outside of Government programs, area set aside, total area planted, and total area harvested. These decisions (behavioral relations) are derived from an objective function that reflects the profit-maximizing behavior of a producer in the presence of Government programs. The second stage involves incorporating total area harvested and other inputs into a production function to obtain total output. Total supply is the sum of total output and total beginning stocks of the commodity.

The demand block consists of seven equations for each of the two sectors. We specified food and feed demands using the standard utility maximization criterion. Total stocks, on the other hand, are specified as the sum of nonrecourse loans, Government-owned Commodity Credit Corporation (CCC) stocks, and privately held free stocks. The stock behavior is based on Cootner's option value theory (*15*) and Working's supply of storage theory (*14*).

The policy block has three traditional corn policy instruments: support price, diversion payment, and loan rate. We adjusted the support price and the diversion payment rates to incorporate the eligibility constraints associated with Government programs (*4, 5*). We based the specification for the policy instruments on Brock and Magee's paradigm for rent-seeking interest groups and conflict resolution (*3*). Variables assigned to the behavioral relationships reflect the policy perspective of the various interest groups (*12*).

The trade block has three behavioral relations and two identities. We used total world coarse grains imports and coarse grains exports of other countries to determine U.S. coarse grain exports. U.S. corn exports is the difference between U.S. coarse grains exports and U.S. other coarse grains exports, and U.S. other coarse grains exports is the difference between total U.S. supply of other coarse grains and domestic utilization. This framework assumes that corn and other coarse grains are perfect substitutes in world trade. We adopted this approach because we assumed that other coarse grains prices were exogenous to the model framework.

The market-clearing identity determines the price of corn. This price refers to the average market price

received by U.S. farmers. Moreover, given that the United States has historically accounted for over 50 percent of world corn trade, we also used this price as the world market-clearing price for the export supply and import demand equations.

A one-period static schematic of the aggregated U.S. coarse grains market illustrates how the supply, demand, policy, and trade blocks interact with one another in any given period (fig. 1). The effective support price and the effective diversion payment primarily affect the recursive supply block. The loan rate influences the stocks variable in the demand block. We deduced the market price through an identity that includes total supply, total domestic demand, and U.S. exports. The endogenous nature of the three policy instruments is not very apparent in this one-period schematic, primarily because policy instruments in any given year are based largely on economic conditions in previous years. Beyond one period, the complex model dynamics for the three policy instruments become more obvious. The support price, for instance, depends on last year's production and yield rate. The diversion payment rate, on the other hand, is determined simultaneously with the support price. Similarly, the loan rate depends on market prices in the previous period, among other things. In general, the lagged endogenous variables provide for the intertemporal linkages in the model (app. table 1).

To summarize, the coarse grains model developed for this study is unique in three ways. First, we assumed that policy variables such as support prices, effective diversion payment rate, and the loan rate are endogenous to the model through a policy block. Second, we recognized the existence of quasi-policy variables such as stocks owned by the Commodity Credit Corporation, stocks under the nonrecourse loan program, area planted under Government programs, and area set aside. These quasi-policy variables reflect the joint economic behavior of both the public and private sectors. Third, the division of coarse grains into corn and an aggregated other coarse grains in the modeling framework allows for cross-commodity effects in the policy formulation process.

Estimating the Policy Equations

One of the unique characteristics of this study is that traditional policy instruments such as support prices, diversion payment rate, and the loan rate are endogenous to the model structure. This characteristic requires directly estimating behavioral equations for the policy instruments. We based the specification of these policy equations on the theory of rent-seeking interest groups developed by Brock and Magee (*3*). Brock and Magee's approach to endogenizing policy variables assumes that rents exist in both the economic and political markets and that economic interest groups compete in political markets for the distribution of income. That approach, therefore, requires that the underlying rent-seeking bargaining game be clearly identified. This identification is accomplished by ensuring that the various interest groups affected by a given policy instrument are represented by variables that can be associated with those particular interest groups in the behavioral relationship which explains that instrument. This situation is particularly important because most Government policy instruments not only affect the various interest groups differently but are also at times in direct conflict with each other's interests.

Effective Support Price

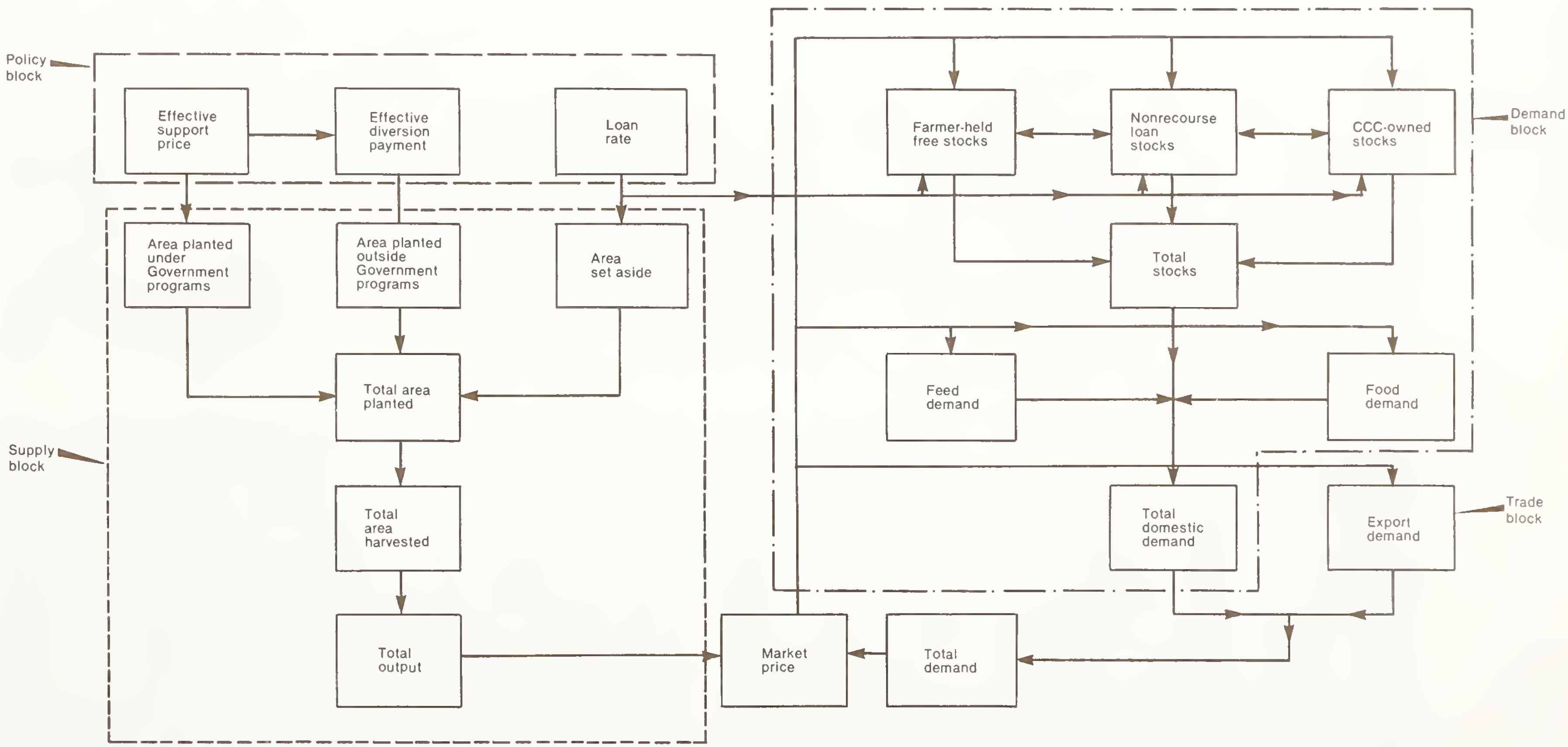
Two interest groups are normally associated with support prices: farmers, who see support prices as an income-maintenance mechanism provided by the Government, and the Government, which is concerned with the effect of high support prices on budgetary deficits. Admittedly, consumers and livestock producers also are affected by the price support schemes, but generally the bargaining power of these two latter groups is not sufficient to alter policy interventions directly. Whatever influences these two groups may exert may already be represented in the Government's cost concerns. Thus, the effective support price which is the "true" price offered by the Government to the farmers for services, is estimated as a function of the lagged value of the ratio of per capita farm income to nonfarm income (LPFYPDY), last year's yield rate (COYHHL), a dummy variable with a zero value for 1960-73 and the actual variable cost of production per hectare for 1974-81 (DUMVCA), and the lagged dependent variable (COESPL) (table 2).[2]

The coefficient of the ratio of per capita farm income to per capita nonfarm income has a negative sign, and its regression coefficient is statistically significant at the 5-percent level (table 2). This situation suggests that the Government compares income in the farm sector with income in the rest of the economy in determining the level of price supports. High per capita farm incomes in relation to per capita nonfarm incomes depress support levels, and vice versa. Hence, agricultural lobbies interested in Government assistance should focus more

[2]We estimated all equations, including those for the three policy instruments, with annual data for the period 1963-81 using the instrumental variable method corrected for first-order serial correction (*5, 6*).

Figure 1

A One-Period Schematic of the Aggregated U.S. Coarse Grains Market



on relative rather than absolute income levels. Consideration of only absolute income could induce the Government to lower support levels even though farmers could be worse-off in relation to the rest of the economy. The relative income approach reflects an income parity concept.

The Congress changed the traditional price support mechanism by 1973 legislation which introduced the target price concept. This legislation, reflecting farmer welfare considerations, mandated that the target price be based on an index of production costs and productivity (per acre yields). The target price would increase when the production costs index or the yield rate increased. The increased target price would compensate farmers for income lost either because of increased production costs or because of falling market prices resulting from increased yields. The regression coefficients for the yield rate and the variable cost of production (COYHHL and DUMVCA) respectively indicate that target prices have responded as intended, and farmer interests therefore appear to be represented in formulating support prices as required by legislation.[3]

The lagged dependent variable represents Government welfare interests. We included this variable to account for political and treasury costs associated with changes in support rates. Large deviations from past values are unlikely because the treasury costs of increasing the support prices to an inappropriately high level, or the political costs of lowering price guarantees, could be substantial. The regression coefficient for the lagged dependent variable (COESPL) is positive and statistically significant at the 5-percent level. A 1-cent increase in last year's effective support price would increase this year's effective support price by 0.44 cent, achieving only 56 percent of the "desired" change because of the political and economic rigidities in the system.

[3]The Food and Agriculture Act of 1977 modified the target price formula and based it on the variable cost of production. The Agriculture and Food Act of 1981, on the other hand, simply mandated the Congress to set the target price levels but authorized the Secretary of Agriculture to raise the levels to meet rising production costs.

Table 2—Estimated equation for effective support price (COESPL)

Variable[1]	Coefficient	Standard error	Shortrun elasticity
Constant	1037	837	
LPFYPDY	-2643	1053	-0.22
COYHHL	.46	.12	.46
DUMVCA	.06	.02	
COESPL	.44	.15	.43

$R^2 = 0.98$, Adjusted $R^2 = 0.97$, $F_{3/15} = 172$

[1]LPFYPDY is the ratio of lagged per capita farm income to per capita nonfarm income. COYHHL is the lagged value for the yield rate for corn. DUMVCA is a dummy variable which uses a value of zero for 1963 to 1973, and the actual variable cost of production between 1973 and 1981. COESPL is the lagged value of the effective support price.

We attempted to identify the influence of Government budget constraints on support price levels by including the ratio of governmental agricultural expenditure to total governmental expenditures, and lagged values of governmental budgetary deficits. Neither of these variables had the hypothesized negative sign. Moreover, the regression coefficients were not statistically significant. We subsequently dropped both. These results may indicate that even though cost concerns are important to the Government, the economics of the farm situation dominate the Government's view on farm programs. The Payment-in-Kind (PIK) program in 1983 dramatically illustrates that despite the rhetoric concerning large budget deficits and an official insistence on curtailing farm program costs, the Government spent over $1 billion in total payments associated with stocks transfer. Moreover, unlike in the eighties, budgetary deficits were not an issue of major concern during the periods covered by the estimated model. This fact may also indicate why the Government budget variable was not statistically significant for the periods over which the model was estimated.

The equation in table 2 leads one to several conclusions. First, the view that support prices are set arbitrarily is naive; the Government follows closely the guidelines set by law and takes into account the relative welfare of the farm community.

Second, production cost is the dominant variable in establishing the support price levels. Similarly, the yield rate is almost as important. If yields decline and production drops, the Government may not see any need for income support, given the higher market prices, and may reduce the support level.

Third, a 1-percent change in the ratio of lagged farm income to disposable income results in a 0.22-percent change in effective support prices. This impact is less than yield rate (0.46) or the lagged dependent variable (0.43), suggesting that the Government considers the nonfarm sources of income available to agricultural workers.

Effective Diversion Payment

The diversion payment is the additional amount that the Government pays farmers to idle land beyond the

minimum set aside requirements. This payment is a bonus incentive in addition to the support price.

The effective diversion payment is determined simultaneously with other policies and is hypothesized to be a function of the level of the effective support price, the expected set aside area, and the variable cost of production.

The actual sign on the regression coefficient for the effective support price variable depends largely on the Government's perception of farmer behavior. If farmers are expected to be very receptive to changes in effective support prices, then the Government may have little incentive to provide both high diversion payment rates and high support prices. An increased effective support price would more than adequately achieve the desired set aside area. Under such circumstances, any increases in effective support payment rates would most likely precede a decrease (or no increase) in effective diversion payment rates, given Government cost considerations. The Government most likely assumes such a scheme for crops with relatively few substitutes in production and use.

On the other hand, if a crop has many substitutes in production and use, the farmers producing such crops may not be very receptive to Government programs. Under these circumstances, the Government would probably present both incentives as a single package. In this case, increased effective support payments would have to be accompanied by increased effective diversion payment rates.

The equation in table 3 shows that the regression coefficient for the effective support price variable (COESP) is positive and statistically significant at the 5-percent level. A 10-cent increase in the effective support price leads to a 3.3-cent increase in the effective diversion payment. This positive relationship apparently reflects the belief the Government presents the farm programs as a package to attract farmers rather than as separate incentives to encourage farmers to join the program at the minimum level and then idle additional land.

The Government establishes the diversion payment rate based on a notion of the area needed to be idled so that the diversion payment variable is a function of the expected area set aside. In an annual model framework, the diversion payment rate and the area set aside are determined simultaneously and move in the same direction. The regression coefficient for the set-aside area variable has the expected positive sign and is statistically significant at the 5-percent level. A 1-percent increase in the expected area set aside would lead to a 1.14-percent increase in the effective diversion payment.

One would expect the Government to take into consideration the variable cost of production per hectare in establishing effective diversion payment rates. The sign for this variable is an empirical question, depending on the receptiveness of the particular group of farmers.

The regression coefficient for the cost of production variable is statistically significant at the 5-percent level. This fact suggests that the Government assumes that increases in the variable cost of production would implicitly make the diversion payments more attractive and would not need to increase the payment rate.

Loan Rate

Two interest groups are normally identified with loan rates; farmers who see guaranteed loan rates as insurance against future income losses resulting from price declines, and the Government which is concerned with the costs that could result from stock build-up or consumer pressures if stocks are too small and retail food prices increase sharply. We hypothesized the loan rate, therefore, to represent the behavior of stockholders, consumers at large, and governmental cost concerns. The loan rate is explained by a future's price variable (COFMP), a commercial interest rate variable (COINT), the lagged value of Government-owned stocks (COCCCL), and the lagged dependent variable (COLRCL) (table 4).

The inclusion of the future's price variable (COFMP) in table 4 is based on the hypothesis that the Government would take into account expected new crop prices in setting loan rates. A high expected market price should increase loan rates for two reasons: Government cost concerns would be minimal given expected low program participation, and the Government may want to

Table 3—Estimated equation for effective diversion payment rate (COEDP)

Variable[1]	Coefficient	Standard error	Shortrun elasticity
Constant	-868	475	
COESP	.330	.11	3.88
COASA	.097	.03	1.14
COVCA	-.050	.02	-2.05

$R^2=0.73$, Adjusted $R^2=0.67$, $F_{3,16}=15.4$

[1]COESP is the effective support for corn. COASA is the area set aside to corn under Government programs. COVCA is the per hectare variable cost of producing corn.

increase loan rates to attract at least some stocks for possible future emergencies. The regression coefficient on the future's price variable has the expected positive sign and is statistically significant at the 10-percent level. The coefficient indicates that a 10-cent increase in the future's price would lead to a 1.9-cent increase in the current year's loan rate, translating into an elasticity of 0.26.

COINT represents the commercial interest rates and reflects the Government's opportunity costs of subsidizing stocks. High opportunity costs should result in lower loan rates. The regression coefficient has the expected negative sign but is not statistically significant, possibly indicating that although the Government is concerned about interest costs, that concern is not sufficiently important to override some of the other concerns that would result from lower loan rates. Moreover, interest cost concerns are a fairly recent phenomenon and may not be especially important in the historical data set for a time when nominal and real interest rates were relatively low and stable compared with the experience since the late seventies.

COCCCL, the lagged value of Government-owned Commodity Credit Corporation stocks, represents the Government's cost and welfare concerns. A high COCCCL implies that program costs are increasing because of an accumulation of program stocks. The regression coefficient for COCCCL is negative and statistically significant at the 10-percent level, apparently indicating that the accumulation of public stocks is a major factor in determining loan rates.

The lagged dependent variable represents both the political and treasury costs associated with loan rates. Given the minimal legislative guidelines set for loan rates and the belief that loan rates set the floor for market prices, any large changes in loan rates could create political and economic costs both at home and abroad. The Government must be extremely cautious in adjusting loan rates. Large decreases in loan rates without adequate income compensation could create a political backlash from farmers, while substantial increases in loan rates would hurt consumers, livestock producers, exports, and the Government budget. To maintain an element of political and economic stability, the Government probably relies on the most recent level to establish the new rate.

Table 4—Estimated equation for the loan rate (COLRC)

Variable[1]	Coefficient	Standard error	Shortrun elasticity
Constant	-158	690	
COFMP	.19	.16	0.26
COINT	-.42	1.32	-.08
COCCCL	-.04	.02	
COLRCL	.88	.19	

$R^2=0.90$, Adjusted $R^2=0.88$, $F_{4,15}=36.4$

[1]COFMP is the April futures for corn to be delivered in December. COINT is the interest rate paid by the Production Credit Association. COCCCL is the lagged value of Government-owned CCC ending stocks. COLRCL is the lagged value of the loan rate variable.

The regression coefficient for the lagged dependent variable is statistically significant at the 1-percent level and supports the hypothesis that the level of the loan rate in the previous year is a dominant factor in determining this year's loan rate. A 10-cent increase in the loan rate in the previous year leads to an 8.8-cent increase in loan rate in the current year. This increase is much larger than the 4.4-cent increase in effective support price resulting from a similar 10-cent increase in lagged effective support price. The Government, therefore, is much more cautious about adjusting loan rates than it is about adjusting support prices. The primary reason is simply that while specific legislative guidelines have been set for the determination of the support price, no such rigid directives have been established for the loan rate, especially for corn.

Simulating and Validating the Model

As mentioned earlier, we estimated the system of equations specified in table 1 for the period 1963 through 1981 using the instrumental variable approach corrected for first order serial correlation. We then used the Gauss-Seidel algorithm (*7*) to solve the system of equations, to validate the model, and to simulate alternative scenarios. For the simulation exercise, we initially set the endogenous variables at their 1963 values, the base year. For all other years, the model operated in a recursive fashion for endogenous variables and used the prespecified values of the exogenous variables.

Comparing the base solution for the system of equations with actual mean values for the various endogenous variables indicates that the policy-endogenous coarse grains model simulates the historical patterns quite well (table 5 and (*5*)), especially for the effective support price and the loan rate variables. The Government-owned Commodity Credit Corporation (CCC) and the nonrecourse loan stocks variables in the demand block are the weakest links in the model. The model's greatest strength is its ability to capture directional changes. The turning point errors are small for most of the variables,

Table 5—Summary of model performance statistics, 1963-81

Block/variable	Unit for (1) and (2)	Actual absolute mean (1)	Estimated absolute mean (2)	Mean absolute relative error (3)	Theil U statistic (4)	Turning point error (5)
				Percent	*——— Ratio ———*	
Policy block:						
Effective support price	Dollars/ton	51.75	51.66	3.6	0.03	0.11
Effective diversion payment	do.	4.14	3.09	13.5	.40	.21
Loan rate	do.	54.72	59.77	12.5	.10	.32
Supply block corn:						
Area planted under Government programs	1,000 hectares	9,057	8,025	13.1	.17	.21
Area planted outside of Government programs	do.	20,759	23,045	20.7	.12	.42
Total area planted	do.	29,903	31,070	6.8	.05	.21
Total area harvested	do.	25,718	26,943	7.9	.06	.37
Total output	1,000 tons	139,284	146,328	9.6	.07	.26
Yield	Tons/hectare	5.35	5.41	4.2	.03	.21
Area set aside	1,000 hectares	5,011	3,749	23.1	.27	.16
Supply block other grains:						
Area planted under Government programs	do.	3,813	3,470	11.8	.16	.32
Area planted outside of Government programs	do.	16,714	16,022	9.2	.08	.16
Total area planted	do.	20,527	19,492	6.8	.06	.26
Total area harvested	do.	15,763	15,036	6.7	.06	.32
Total output	1,000 tons	38,607	37,190	9.3	.08	.32
Yield	Tons/hectare	2.47	2.49	5.2	.04	.21
Area set aside	1,000 hectares	2,071	1,613	18.2	.28	.36
Demand block corn:						
Food demand	1,000 tons	12,136	12,989	10.2	.08	.26
Feed demand	do.	95,161	10,029	9.9	.07	.26
CCC stocks	do.	4,978	8,640	30.32	.42	.21
Loan stocks	do.	6,606	8,469	23.2	.31	.32
Free stocks	do.	10,765	10,741	17.6	.15	.21
Total stocks	do.	26,082	31,582	35.8	.18	.16
Average market price	Dollars/ton	72.18	68.70	8.4	.07	.26
Demand block other grains:						
Food demand	1,000 tons	5,114	5,115	3.1	.03	.53
Feed demand	do.	27,768	26,603	15.9	.13	.53
CCC stocks	do.	4,570	4,620	46.1	.24	.32
Loan stocks	do.	2,495	1,890	18.8	.46	.37
Free stocks	do.	6,743	7,040	14.5	.12	.53
Total stocks	do.	14,478	14,221	12.6	.12	.21
Trade block:						
U.S. coarse grain exports	do.	37,511	38,819	14.4	.09	.32
World coarse grain exports	do.	70,319	71,480	6.1	.05	.16
Corn exports of other exporters	do.	16,260	15,913	6.2	.05	.21
Other coarse grains exports of other exporters	do.	16,551	16,755	6.7	.04	.21

especially the corn variables. Even the CCC, nonrecourse loan, and total stocks equations, despite their large prediction errors, capture the historical movement well. Other coarse grains variables, on the other hand, have relatively more turning point errors, but the prediction errors associated with the turning point errors are normally less than 10 percent. More turning point errors are associated with other coarse grains than with corn because variables associated with this composite commodity often move in conflicting directions. The model validation results suggest that the model is appropriate for simulating alternative policy scenarios, especially for the policy variables. However, one must exercise special caution when interpreting the changes in the magnitudes of the CCC and nonrecourse loan stocks variables.

Policy Response Analysis

We simulated Government responses to changes in the economic environment using a counterfactual approach, that is by comparing hypothesized behavior against observed behavior. Such an approach provides a benchmark against which to judge potential Government behavior. Furthermore, information acquired through this "what if" procedure can be used to predict probable Government response should similar situations occur in the future.

The scenarios examined are for the period 1976 through 1981. These 6 years were chosen for three reasons. First, the period covers the 6 years during which the Food and Agricultural Act of 1977 was formulated and implemented. At the time the study was conducted, sufficient published data were not available to fully analyze program behavior under the Agriculture and Food Act of 1981. The intention was to examine how Government coarse grain programs during this period might have differed had there been selected shocks to the coarse grain sector in 1976, the period immediately preceding the signing of the 1977 act. Second, 1976 was the first year since the export market upheaval which began in 1972 in which the U.S. and world coarse grains market regained short-run stability. Third, as suggested by the model validation results, considerable confidence can be placed in the model's predictive capability for the period 1976 through 1981.

The six scenarios examined include (1) a decrease in U.S. corn production, (2) an increase in U.S. corn production, (3) an increase in the cost per hectare to produce corn, (4) a ceiling placed on the total quantity of corn in the Farmer-Owned Reserve, (5) an increase in coarse grains exports by an exogenously specified growth rate that is less than the observed rate, and (6) a loan rate formula based on a moving average of market prices.

Three points should be noted concerning the format. First, although the primary focus of this report is to analyze Government responses to exogenous changes, we also paid attention to the responses of domestic producers and consumers as well as importer behavior. Second, our format emphasizes the dynamics of the system by focusing primarily on the sequential reactions of decisionmakers over the time period covered. We paid attention more to the adjustment mechanism than to the magnitudes of changes. Finally, we primarily emphasized the corn sector.

Production Shortfall

Experience over the last two decades suggests that no single event can more dramatically alter the environment in which policy decisions must be made than a major, unanticipated decline in production. The first scenario addresses this issue. For the first scenario, we assumed a 33-percent shortfall in U.S. corn production in relation to actual production in 1976. The specified shortfall in corn production is similar to the one in 1983 when Government programs and dry weather reduced corn yields and output by 28 percent and 49 percent, respectively, below the 1982 levels. Similar production shortfalls—though not nearly of the same magnitude—also were experienced in 1970, 1974, and 1980. Thus, this scenario reflects a situation which may confront policymakers in the future. In this analysis, we reduced corn production in 1976 by one-third from the observed level of 159.4 million tons to 106.5 million tons. A shock of this magnitude, though quite drastic, permits us to examine the stability of the system and its ability to handle large shocks and to study how far into the future such shocks are likely to affect the economic and political environment.

Based on the simulation results, a 33-percent decline in corn production in 1976 would have increased the market price by 64.8 percent over the base solution in 1976 (table 6)[4]. This price increase would have resulted in an additional 15.2 million tons of total corn stocks being released to the market. Nonrecourse loan stocks would have accounted for 7 million tons (46 percent) of this release, followed by 5.6 million tons (36.8 percent) from farmer-held free stocks, and 2.7 million tons (17.8 percent) from Government-owned CCC stocks.

[4]For more detailed results for this and the other five scenarios, see (5).

Several factors might explain the relatively large response of loan stocks to the market price:

- First, farmers can withdraw loan stocks from the Government nonrecourse loan program whenever they wish and not incur a penalty. This ease of withdrawal is not true for the Farmer-Owned Reserve which has a release mechanism or Government-owned CCC stocks for which the market price has to reach a prespecified minimum proportion of the loan rate before any stocks can be released.

- Second, free stocks are private stocks that include working stocks for transactions purposes and hence are not as likely to respond to changes in prices as are loan stocks. This situation is especially true for corn which is being stored for onfarm livestock feeding.

- Third, given the inverse relationship between free stocks accumulation and loan and CCC stocks buildup, some of the decreases in free stocks resulting from higher prices would have been moderated by the decrease in CCC and loan stocks which put upward pressure on free stocks accumulation.

The 64.8-percent price increase would have led to declines in food demand (35 percent) and feed demand (24 percent). The decline in feed demand, moreover, would have accounted for nearly half of the shortfall in production. Based on consumption

Table 6—Impact on selected variables of a 33-percent exogenous production shortfall in 1976[1]

Commodity/variable	Unit	1976	1977	1978	1979	1980	1981
Corn:							
Effective support price	Dollars/ton	59.80	57.25	68.79	74.84	80.51	86.78
		(0)	(-8.55)	(-3.57)	(-1.6)	(-.74)	(-.32)
Effective diversion payment	do.	0	0	2.89	3.38	1.63	0
		(0)	(2.88)	(-1.94)	(-.53)	(-.40)	(0)
Loan rate	do.	71.95	80.46	84.57	88.02	91.41	94.93
		(0)	(4.35)	(4.50)	(4.37)	(4.53)	(4.68)
Area in Government programs	Million hectares	0	0	5.08	5.64	0	0
		(0)	(0)	(-1.08)	(-.01)	(0)	(0)
Area outside of Government programs	do.	32.67	35.58	27.00	26.03	32.45	32.56
		(0)	(3.80)	(1.47)	(-.06)	(.09)	(.05)
Total area planted	do.	32.67	35.58	32.08	31.67	32.45	32.56
		(0)	(3.80)	(.38)	(-.07)	(.09)	(.05)
Production	Million tons	106.50	191.93	177.45	182.02	156.49	194.23
		(-52.80)	(22.76)	(2.03)	(-.62)	(.51)	(.27)
Total stocks	do.	13.79	37.13	41.77	43.30	28.73	52.03
		(-15.17)	(.63)	(.62)	(.25)	(.55)	(.74)
Exports	do.	35.70	55.07	51.66	58.42	50.07	56.17
		(-7.50)	(6.75)	(.56)	(.10)	(.37)	(.27)
Feed demand	do.	78.08	99.26	105.23	104.77	101.83	94.54
		(-25.07)	(.17)	(1.23)	(-.14)	(-.15)	(-.17)
Market price	Dollars/tons	126.28	78.19	80.46	90.84	102.65	117.08
		(49.66)	(.33)	(3.00)	(.38)	(.42)	(.45)
Other coarse grains:							
Area in Government programs	Million hectares	0	0	3.12	3.49	0	0
		(0)	(0)	(-.46)	(.06)	(0)	(0)
Area outside of Government programs	do.	20.23	15.70	14.14	14.29	18.18	18.79
		(0)	(-2.12)	(.65)	(.26)	(.01)	(.02)
Total area planted	do.	20.23	15.70	17.25	17.79	18.18	18.79
		(0)	(-2.12)	(.19)	(.33)	(.01)	(.02)
Production	Million tons	41.95	34.34	37.69	39.36	35.94	42.61
		(0)	(-3.66)	(.36)	(.59)	(.02)	(.04)
Feed demand	do.	30.02	24.37	25.81	24.94	19.11	25.17
		(6.81)	(-.04)	(-.36)	(.04)	(.04)	(.04)
Exports	do.	11.0	-.52	5.23	9.52	12.67	9.22
		(-2.05)	(-6.68)	(-.06)	(.04)	(-.43)	(-.33)
Coarse grains exports	do.	46.70	54.53	56.89	67.94	62.74	65.39
		(-9.55)	(.06)	(.50)	(-.06)	(-.05)	(-.06)

[1]The numbers in parentheses represent changes from base value.

shares, feed demand would have absorbed the majority of the shock from the crop shortfall.

In the first year, the effects of the production shortfall on the other coarse grains market would have been very similar. Total ending stocks would have declined by 43 percent. Within total stocks, loan stocks would have declined the most followed by free stocks and CCC stocks, indicating once again that loan stocks respond faster to price changes than either free or Government-owned CCC stocks demands. The quantity of other coarse grains demanded for feed use would have increased by 29.3 percent in response to the higher price of corn. This increase would have been insufficient to offset the decline in corn usage, and total coarse grains demand for feed purposes declined by 14.5 percent in this first period as a result of the sharp decline in corn use.

In addition to the domestic market, shortfalls in corn production also would be felt in the export market. U.S. coarse grains exports would have declined by 9.6 million tons. Corn exports would have accounted for 78 percent (7.5 million tons) of the decrease, while other coarse grains would have accounted for the remaining 2.1 million tons.

In 1977, the second period, the simulation results indicate that the Government would have responded by reducing the effective support price from the base level by $8.55 per ton (13 percent). This reduction may have been an attempt by the Government to discourage participation in Government programs when farm income increases. This reduction in the effective support price could have taken one of two forms: reduced target prices with no changes in the associated program requirements; or unchanged target prices, but reduced effective support prices through greater restrictions on set-aside requirements, or yield payment rates. The second alternative may be politically more palatable. The model suggests that this reduced support price in turn would have caused the Government to completely do away with the diversion payment, that is, the Government did not feel a need to provide incentives to divert additional land beyond the minimum requirements.

Even prior to the production shock, no land was brought under Government programs in 1977. Hence, with increased prices and reduced support payment, the situation remained the same. However, total land planted to corn would have increased by 12 percent, which would have increased output by 13.5 percent. The market price for corn declined in response to the increased supply and nearly matched the base solution.

The Government would have responded to the increase in the previous year's price by increasing the loan rate from $72 per ton in 1976 to $80.46 per ton in 1977. This increase is greater than the base solution by $4.40 per ton. Hence, a 64.8-percent increase in the market price would have resulted in a loan rate increase over the base solution of only 5.7 percent.

The increases in the loan rate and crop production in this second year would have provided an incentive for farmers to use the loan program. Consequently, additional corn would have entered the loan program, with a 29.2-percent increase from the base solution of 9.13 million tons. CCC stocks would have been 1.4 million tons greater than the 1976 quantity, and free stocks would have increased by 2.6 million tons. The increase in free stocks would have been the result of a decrease in price (speculative motive), and an increase in production (transactions motive). Consequently, total corn stocks demand would have more than doubled between 1976 and 1977.

For the other coarse grains market, the increase in the corn price in the first period would have decreased production by 9.6 percent in the second period. Similarly, the price decline in the second period would have caused total ending stocks for other coarse grains to decline by 13.4 percent. Feed and food demands would have equaled the preshock equilibrium levels.

The total increase in U.S. coarse grains exports in this second period would have been minimal. The 70,000-ton increase would have been the net of a 6.75 million ton (14-percent) increase in corn exports, and a 6.68-million-ton (10.8-percent) decline in other coarse grains exports. The U.S. would have switched from a net exporter to a net importer for other coarse grains. These imports were necessitated largely because of a 3.66-million-ton decline in other coarse grains production.

By the third year, corn and other coarse grains production, total demand, and market price would all have been within 2-percent of the original 1978 levels. There would still have been some movement in the policy variables. The effective support price would have been still lower than the base solution by 4.9 percent, while the loan rate would have been higher by 5.6 percent. The lower effective support price would have created a shift between the participating and nonparticipating area for both corn and other coarse grains, but the overall impact on the total area planted and production would have been very small. Similarly, the higher loan rate would have resulted in some movement between CCC and loan stocks even though free

and total stocks demands would have stabilized. Overall, by the third period, the system would have returned to its original status.

To conclude, we can make a number of observations concerning this scenario.

- First, a 33-percent shortfall in corn production in 1976 could have had wide-ranging effects on the corn sector. Total stocks and feed demand would have absorbed most of the shock in the first period, and U.S. coarse grains export demand would have declined modestly. The relatively low elasticity of world import demand was responsible for this low response. U.S. corn output would have increased in the second period, lessening the pressures on market price. In the second period, the export sectors for both corn and other coarse grains would have still been adjusting to the internal shock. By the third period, the system would have been close to an equilibrium. Feed demand, exports, and production would have been within 2 percent of the base solution. Market price, on the other hand, would have been within 1 percent of the base solution.

- Second, the policy variables would have been affected for a longer period of time as a result of the shortfall. A 4-year adjustment period would have been necessary for the effective support price to reach its original level. This situation suggests that once having lowered support prices, the Government would be slow to raise them. Similarly, once the loan rate had been increased, the Government would be unlikely to reduce loan rates because of the political costs associated with such a move. These probabilities, as indicated earlier, were reflected in the relatively large coefficient for the lagged dependent variable.

- Third, there would have been some substitution between corn and other coarse grains in production and feed use. However, the magnitudes of the changes for the other coarse grains variables in relation to the corn variables appear to be small, and the effect on the total coarse grains system would be minimal.

Production Expansion

This scenario explores the consequences of an exogenously determined above-normal increase in corn output similar to the situation in 1981 and 1982. The objective of this exercise is to examine the effectiveness of Government policies when prices and net farm incomes are low as the result of a large crop. We performed the analysis by increasing corn production in 1976 by 33 percent from a base solution of 159.6 million tons to 216.8 million tons.

The immediate effect of an exogenous 33-percent increase in corn production would be to create an excess supply at the original equilibrium price (table 7). Consequently, the market price would have declined by 47.2 percent from a base value of $76.62 per ton to $40.45 per ton. The loan rate would have been $71.95 per ton. Although the market price has fallen below the loan rate in past periods of excess supply (as in the early sixties), the extent of the decline is surprising. Such a large decline suggests that the system cannot absorb enough stocks to maintain prices at the loan rate, reflecting the inadequacy of an econometrically estimated stocks demand curve that is not perfectly elastic at prices below or at the loan rate.

The quantity of corn demanded for food, feed, and total stocks all would have increased in response to the fall in price. But unlike the first scenario where feed demand would have absorbed most of the shock, stocks demand would have accounted for the largest increase (39.9 percent), followed by feed demand (34.6 percent) and food demand (7 percent). This asymmetry in absorption occurs because there is no restriction on the accumulation of stocks in years of falling prices, whereas the release of stocks in years of rising prices is limited by the total quantity of beginning stocks available. Beginning stocks of corn in the first year totaled 30.3 million tons, or 19 percent of total supply.

The decreased price of corn also would have affected the other coarse grains sector. Stocks demanded would have increased by 70.6 percent from 11.1 million tons to 18.9 million tons. The decrease in the price of corn would have resulted in the substitution of corn for other coarse grains for feed purposes, and feed use of other coarse grains would have declined by 5 million tons (21.4 percent). The quantity of total coarse grains feed demand, however, still increased by 13.2 million tons (10.5 percent) because of an 18.3-million-ton increase in the quantity demanded of corn for feed purposes.

In the export market, the lower price of corn would have increased U.S. coarse grains exports by 7 million tons. This increase would reflect a 9.8-million-ton increase in corn exports, and a 2.9-million-ton decrease in other coarse grains exports. Hence, even though the changes in U.S. coarse grains exports appear to be relatively small (12.4 percent), the changes in the corn (22.7 percent) and other coarse grains (21.9 percent) exports individually would have been much larger.

In the second year, 1977, the Government would have responded by increasing both the effective support price and the effective diversion payment rate. These responses would have reflected the Government's attempt to compensate farmers for the extremely low incomes in the first period resulting from the declining corn price. The Government would have raised the effective support price by $8.54 per ton from a base value of $65.80 to $74.34 per ton. The effective diversion payment rate, on the other hand, would have risen even more, from $2.88 per ton to $16.26 per ton. This large increase in the diversion payment rate may reflect an attempt by the Government to encourage the idling of additional land to reduce the excess supply.

The combination of decreased prices in the first period and increased effective support price and diversion payment rates in the second period would have brought 19.9 million hectares of corn land into Government programs in the year immediately following the large crop. Conversely, the area planted outside Government programs would have fallen dramatically, accounting for only 21.4 percent of the total area planted to corn. The total area planted to corn fell by 6.4 million hectares (20.3 percent). The total area planted and idled under Government programs would have been larger than the total area planted prior to the record bumper crop, however. The Government program apparently would become so attractive that marginal land not usually considered for corn plantings would be designated as corn area. Such activity would represent the "slippage" that normally occurs with acreage diversion programs.

The effects on the other coarse grains supply block would have been mixed. The decrease in the price of

Table 7—Impact on selected variables on an exogenous 33-percent increase in production in 1976[1]

Commodity/variable	Unit	1976	1977	1978	1979	1980	1981
Corn:							
Effective support price	Dollars/ton	59.80 (0)	74.34 (8.54)	75.35 (2.99)	77.80 (1.36)	81.87 (.62)	87.35 (.25)
Effective diversion payment	do.	0 (0)	16.26 (13.38)	6.16 (1.42)	4.39 (.48)	2.43 (.40)	0 (0)
Loan rate	do.	71.95 (0)	72.86 (-3.25)	76.82 (-3.25)	80.46 (-3.19)	83.48 (-3.40)	86.67 (-3.58)
Area in Government programs	Million hectares	0 (0)	19.91 (19.91)	6.80 (.64)	5.69 (.04)	0 (0)	0 (0)
Area outside of Government programs	do.	32.67 (0)	5.43 (-26.35)	24.72 (-.81)	26.10 (.01)	32.23 (-.13)	32.45 (-.06)
Total area planted	do.	32.67 (0)	25.34 (-.64)	31.52 (-.13)	31.79 (.05)	32.23 (-.13)	32.45 (-.06)
Production	Million tons	212.10 (52.80)	129.24 (-39.93)	174.65 (-.77)	183.10 (.46)	155.21 (-.77)	193.56 (-.40)
Total stocks	do.	50.02 (21.06)	35.89 (-.61)	41.57 (.42)	43.72 (.67)	28.36 (.18)	51.21 (-.08)
Exports	do.	53.01 (9.81)	31.23 (-17.08)	50.50 (-.60)	58.28 (-.24)	49.08 (-.62)	55.43 (-.47)
Feed demand	do.	121.42 (18.27)	98.09 (-1.00)	103.01 (-8.99)	104.97 (.36)	102.26 (.28)	94.98 (.27)
Market price	Dollars/ton	40.45 (-36.17)	80.48 (1.96)	85.86 (2.40)	89.43 (-1.03)	101.45 (-.78)	115.85 (-.78)
Other coarse grains:							
Area in Government programs	Million hectares	0 (0)	11.31 (11.31)	3.80 (.22)	3.39 (-.04)	0 (0)	0 (0)
Area outside of Government programs	do.	20.23 (0)	13.32 (-4.50)	12.97 (-.52)	13.82 (-.21)	18.26 (.07)	18.86 (.05)
Total area planted	do.	20.23 (0)	24.63 (6.81)	16.77 (-.29)	17.21 (-.25)	18.26 (.07)	18.86 (.05)
Production	Million tons	41.95 (0)	50.42 (12.33)	36.78 (-.55)	38.31 (-.46)	36.08 (.12)	42.74 (.09)
Feed demand	do.	18.24 (-4.97)	24.66 (-10.25)	26.45 (.28)	24.79 (-.11)	19.00 (-.07)	25.07 (-.06)
Exports	do.	10.19 (-2.86)	22.88 (16.72)	5.49 (.20)	9.87 (.39)	13.82 (.72)	10.11 (.56)
Coarse grains exports	do.	63.20 (6.95)	54.11 (-.36)	55.99 (-.40)	68.15 (.15)	62.90 (.11)	65.54 (.09)

[1]The numbers in parentheses represent changes from base value.

corn would have increased the area planted to other coarse grains. Conversely, the increased effective support price would have increased participation in Government programs and reduced the total area planted. The net effect in this particular scenario would have been a 38.2-percent increase in other coarse grains total area planted. Total other coarse grains output would have increased by 12.3 million tons (32.4 percent), but the 39.9-million-ton (23.6-percent) decline in corn output would have decreased total coarse grains output by 27.6 million tons (13.3 percent).

The decrease in total coarse grains output would put upward pressure on prices, and the market price of corn would have increased from $40.45 per ton in the first year following the shock to $80.48 per ton in the second year. The price, however, would have been 2.5 percent above the original level, indicating a modest overreaction by the Government in response to a large shock. This price increase would have been accompanied by a decline in the quantity of corn demanded for food, feed, and total stocks. The decline in total stocks would reflect a combination of the effects of an increase in the market price and a 4.3-percent decline in loan rates.

Total U.S. coarse grains exports would have decreased by less than 1 percent in response to the increased prices. However, this is deceptive. The 360,000-ton decrease would reflect a 17.1-million-ton (35.4-percent) decrease in corn exports, and a 16.7-million-ton increase in other coarse grains exports. Because other coarse grains exports are defined as the difference between total supply and domestic demand, the increased production accompanied by the decreased feed demand would result in a large increase in other coarse grains exports.

By the third year, corn and other coarse grains production, total demand, and market price would have been within 2 percent of the base solution. Policy variables, especially the effective diversion payment variables, would still show some instability. Similarly, the lower loan rate would cause some movements between Government-owned and nonrecourse loan stocks.

A number of general observations can be made based on the model results:

- First, the first year effects of an increase in corn production would be confined to the demand and trade sectors for both corn and other coarse grains. Most of the adjustments of the increased production would be absorbed by total stocks and feed demands.

- Second, unlike when prices are high, farmers would have been very responsive to the Government programs when prices and incomes were low. Nearly 80 percent of total corn area planted in the second year would have been enrolled in the Government program compared with no area under Government programs prior to the shock. These figures indicate that Government corn programs have indeed been effective as a means of income and price supports in periods of expanded output and depressed prices. This situation is in contrast to their relevance in times of rising prices as illustrated in the previous scenario. The effect for other coarse grains was not quite so dramatic, largely because oats and millet, among the other coarse grains, are not covered by Government programs.

- Third, the exogenous production increase would have affected the policy variables for a longer length of time than the private sector variables.

- Fourth, a considerable substitution would exist between corn and other coarse grains in production, feed demand, and exports. This substitution between corn and other coarse grains would have been a key element in stabilizing the system despite the large shocks.

Increased Production Costs

The per hectare variable production cost in the model structure represents both an aggregate input price faced by coarse grains producers and a proxy for the general inflation rate. We hypothesized the variable to affect the economic system in two ways. First, policymakers use the variable as a guideline to establish the effective support price. Farm groups would probably lobby for higher price supports in the event of increased input costs. Second, farmers take into account input costs in deciding both the area planted and the level of Government program participation because increased input costs might make Government program provisions more attractive.

The third scenario addresses these issues. We analyzed the effects of a steady increase in the per hectare production costs—a proxy for an increase in the inflation rate—on the decisionmaking process for consumers, producers, and the Government. The per hectare variable production cost and the price index of fertilizer are exogenously increased by 30 percent above the observed rate for the period 1976-81.

The 30-percent increase in the per hectare variable cost of production would have increased the effective

support price by 6.4 percent from $59.80 per ton to $63.65 per ton in the first year (table 8). However, this increase would have no immediate effect on the system because no coarse grains would have been planted under Government programs in 1976. The increase in input costs, however, would have resulted in a 2.1-percent decline in the total area planted. Corn output would have fallen by 3.4 percent from 159.3 million tons to 154 million tons. The reduced total supply would have increased price by $6.15 per ton (8 percent). The quantity of corn demanded for food (4.3 percent), feed (8 percent), and total stocks (9.1 percent) would all have declined. The fall in free stocks demand would have accounted for over 45 percent of the decline in total stocks demand.

The higher price in the first year mitigated some of the downward pressures on production in the second year. Hence, corn production in 1977 deviated from the base solution by only 1.5 percent. Similarly, the market price was closer to the base solution than in the first year, as was true for all the demand variables.

The aforementioned demand-supply adjustment pattern continued for the rest of the 6-year period, with market prices higher and corn output lower than the base solution values. We can make a number of general observations based on the model results concerning the 6 years which were analyzed:

- First, in response to increased input costs, the Government steadily increased the effective support price. The effective diversion payments and set-aside area were at zero or negative levels.

- Second, in the 2 years, 1978 and 1979, that Government programs did exist, farmers in the program would have reduced their areas planted

Table 8—Impact on selected variables from an exogenous increase in the per hectare variable cost of producing corn, 1976-81[1]

Commodity/variable	Unit	1976	1977	1978	1979	1980	1981
Corn:							
Effective support price	Dollars/ton	63.65 (3.85)	71.14 (5.34)	78.88 (6.52)	84.14 (7.70)	90.50 (9.25)	97.96 (10.86)
Effective diversion payment	do.	0 (0)	.75 (-2.13)	2.78 (-1.96)	1.97 (-1.94)	0 (-2.03)	0 (0)
Loan rate	do.	71.95 (0)	76.89 (.78)	81.36 (1.29)	85.51 (1.86)	89.39 (2.51)	93.58 (3.33)
Area in Government programs	Million hectares	0 (0)	0 (0)	5.47 (-.69)	5.19 (-.46)	0 (0)	0 (0)
Area outside of Government programs	do.	32.00 (-9.67)	31.55 (-.23)	25.94 (.41)	28.42 (.33)	32.04 (-.32)	32.25 (-.26)
Total area planted	do.	32.00 (-.67)	31.55 (-.23)	31.42 (-.28)	31.61 (-.13)	32.04 (-.32)	32.25 (-.26)
Production	Million tons	153.96 (-5.34)	166.69 (-2.48)	172.60 (-2.82)	180.61 (-2.03)	152.75 (-3.23)	191.17 (-2.79)
Total stocks	do.	26.43 (-2.53)	34.30 (2.20)	38.86 (-2.29)	40.88 (-2.17)	25.74 (-2.44)	49.07 (-2.22)
Exports	do.	42.88 (-.32)	48.77 (.46)	51.32 (.22)	58.57 (.05)	50.27 (.57)	56.94 (1.04)
Feed demand	do.	100.05 (-3.10)	96.37 (-2.72)	101.55 (-2.45)	102.37 (-2.24)	98.98 (-3.00)	91.30 (-3.41)
Market price	Dollars/ton	82.77 (6.15)	83.87 (5.35)	89.43 (5.97)	86.90 (6.44)	110.72 (8.49)	126.18 (9.55)
Other coarse grains:							
Area in Government programs	Million hectares	0 (0)	0 (0)	3.51 (-.07)	3.43 (0)	0 (0)	0 (0)
Area outside of Government programs	do.	20.06 (0)	17.44 (0)	13.31 (-.18)	13.69 (-.34)	17.77 (-.42)	18.20 (-.61)
Total area planted	do.	20.06 (-.17)	17.44 (-.38)	16.82 (-.24)	17.13 (-.33)	17.77 (-.42)	18.20 (-.61)
Production	Million tons	41.37 (-.58)	37.17 (-.92)	36.67 (-.66)	37.95 (-.82)	34.95 (-1.01)	41.28 (-1.37)
Feed demand	do.	24.05 (.84)	25.10 (.69)	26.89 (.72)	25.60 (.70)	19.88 (.81)	25.95 (.82)
Exports	do.	12.19 (-.86)	4.72 (-1.44)	4.07 (-1.22)	8.48 (-1.00)	11.41 (-1.69)	7.35 (-2.20)
Coarse grains exports	do.	55.07	53.49	55.39	67.05	61.68	64.29

[1]The numbers in parentheses represent changes from base value.

more than those not in the programs. Those farmers in the program felt that the Government did not compensate them adequately in view of increased input costs and rising market prices.

- Third, the loan rate increase would have been much more moderate than the changes associated with the effective support price and the market price, because the effective support price is directly tied to the cost of production.

- Fourth, after the initial shock of a 5.34-million-ton decrease in corn output in 1976, the decrease in output would be lower for the subsequent years when the increased prices would encourage production expansion. We also observed this same moderating chronological influence on the demand variables.

- Finally, the results for other coarse grains were identical. Total output of other coarse grains and total ending stocks demand would have declined for the entire period in response to both the increase in the corn price and the variable production cost. However, feed demand for other coarse grains would have increased marginally because of the increase in the corn price.

Ceiling on the Farmer-Owned Reserve

The Farmer-Owned Reserve, initiated by the Food and Agriculture Act of 1977, was designed for two specific purposes. First, the reserve was to serve as an emergency reserve for food (grains) supplies in the event of another food crisis such as in 1974. Second, the reserve was to be a price management mechanism that the Government could use to either release or accumulate stocks in periods of market price volatility.

In the first 3 years of the program, the grain market was characterized by rising prices and increased demand, and the Farmer-Owned Reserve essentially fulfilled the aforementioned objectives. However, following the Carter administration's January 1980 decision to limit grain sales to the Soviet Union, the Farmer-Owned Reserve has served as a price support mechanism as well as a food reserve system. Critics point out that in 1981, for instance, Farmer-Owned Reserve stocks accounted for 57 percent of total ending corn stocks, sharply contrasting with the 32 percent in Farmer-Owned Reserve stocks between 1978 and 1980. The total volume of ending corn stocks in the Farmer-Owned Reserve further increased in 1982 to 39.3 million tons, and the Government introduced the Payment-in-Kind program to dispose of the stocks.

The use of the Farmer-Owned Reserve for conflicting objectives has led to suggestions that a ceiling be imposed on the quantity of grains that can enter the reserve. Such a ceiling would divert the increasingly costly reserve buildup into Government-owned (CCC) and farmer-held free stocks. Such a diversion would serve two purposes: the Government would have complete control over the stocks that it pays to store, and Government costs may be lower because of lower storage payments and smaller interest concessions.

One proposal for the ceiling level has been a billion bushels (40 million tons) of coarse grains. For purposes of this study, however, this would not be a meaningful number because the Farmer-Owned Reserve ending stocks between 1977 and 1981 never reached that level. Therefore, the Farmer-Owned Reserve ceilings are set at a much lower level, 10 million tons of corn. There are two specific purposes for this low ceiling. First, the issue is of academic interest because the focus of this study is to examine the qualitative impacts of the ceiling. Such interest would be better served through a large rather than a small perturbation. Second, an overall objective of this study was to examine the impact of various shocks on the economic and political environment from 1976 through 1981. A 10-million-ton ceiling would affect 4 of the 6 years we studied.

A 10-million-ton ceiling on the Farmer-Owned Reserve would have affected the coarse grains sector beginning in 1978 when Farmer-Owned Reserve corn stocks would otherwise have been 13.9 million tons (table 9). All the effects of the ceiling in 1978 would have been confined to the demand variables. Neither the policy variables nor the supply variables would have been affected.

A decline in Farmer-Owned Reserve levels would have immediately increased farmer-held free stocks. But free stocks can only absorb a third of this decline, and the rest would be pushed into the open market where prices would decline. The fall in the price would allow nonrecourse loans and CCC stocks to absorb some of the shock. Increases in the quantity demanded for food, feed, and exports would absorb the rest of the effects. At the end of the first year, free stocks levels would have increased by 11.3 percent followed by 5 percent for CCC stocks and 2.8 percent for loan stocks. The combination of the Farmer-Owned Reserve decline and increases in other stocks would result in a 4.7-percent decline in total stocks. Similarly, the market price would fall by 3.5 percent as quantities of corn demanded for food and feed purposes would increase by 1.5 percent, respectively.

The pattern established in 1978 would almost repeat itself in 1979. Free stocks and CCC stocks would increase by 12.7 percent and 8.1 percent, respectively. Loan stocks and total stocks, however, would decline by 1.2 percent and 11.7 percent, respectively. This decline could indicate the unwillingness of producers to enter into the loan program in the absence of the Farmer-Owned Reserve 3-year extension provisions. The quantity of corn demanded for food, feed, and exports all increased, but by negligible proportions, as did total area planted and total output.

In 1980, the pattern reversed itself because no Farmer-Owned Reserve ending stocks were held. Hence, the reduced supply resulting from the lower beginning stocks led to higher prices and less corn demanded for food, feed, exports, and total stocks. The 5.4-percent price increase resulted in 13.1-percent and 4.5-percent declines in loan and free stocks, respectively.

The qualitative effects on the corn market pertinent to 1978 and 1979 would have been repeated in 1981 when the restrictions reduced Farmer-Owned Reserve stocks from 33 million tons to 10 million tons. The ceiling would have resulted in total stocks declining by 12 million tons or 23.4 percent. Over one-third of this decline would be absorbed by free stocks which would increase from 5.9 million tons to 13.7 million tons. Similarly, CCC stocks would increase by 1.8 million tons and loan stocks by 1.5 million tons. The release of the stocks would lead to a decline in the market price from $116.60 per ton to $95.90 per ton. The quantity of food (6.8 percent), feed (7.8 percent), and export demand (6.5 percent) all would have increased. The price decrease also would have lowered loan rates in 1982, lowering total stock levels.

The model results suggest that imposing a ceiling on Farmer-Owned Reserve stocks would increase free and CCC stocks accumulation. Nonrecourse loan stocks would increase very little and may, under certain circumstances, decline. Total stocks, on the other hand, would decline substantially. Moreover, a significant decline in market prices resulting from such ceilings would lower loan rates, and total stocks would decline even more. The effect on Government treasury costs of such a ceiling is uncertain. Although the Government may save some expenditures because of reduced storage payments and fewer subsidized loans, the lower market price could increase deficiency payments.

Slow Export Growth

Even though the export market has been a major source of revenues for the U.S. farm sector, export behavior has varied widely. Between 1970 and 1980, for instance, U.S. coarse grains exports grew at an annual rate of 14 percent. Between 1981 and 1984, on the other hand, coarse grains exports declined at an annual rate of 4.2 percent. Although 1984 coarse grains exports were higher than in 1983 by 2.5 percent, these exports will probably not increase in the eighties at a rate comparable to that of the seventies.

Table 9—Impact on selected corn variables of a 10-million-ton ceiling on the Farmer-Owned Reserve corn stocks, 1978-81[1]

Item	Unit	1978	1979	1980	1981
Loan rate	Dollars/ton	80.07	83.39	86.40	90.23
		(0)	(-.26)	(-.48)	(-.02)
Commodity Credit Corporation stocks	Million tons	6.77	6.97	6.38	6.62
		(.32)	(.52)	(.01)	(1.77)
Nonrecourse loan stocks	do.	9.13	8.08	5.13	8.97
		(.25)	(-.10)	(-.77)	(1.52)
Privately held "free" stocks	do.	13.30	13.93	15.04	13.71
		(1.35)	(1.57)	(-.71)	(7.77)
Total stocks	do.	39.20	38.98	26.55	39.30
		(-1.95)	(-4.07)	(-1.63)	(-11.99)
Food demand	do.	15.91	17.78	18.82	21.62
		(.24)	(.15)	(-.31)	(1.37)
Feed demand	do.	105.20	105.38	100.02	102.11
		(1.20)	(.77)	(-1.96)	(7.40)
Exports	do.	51.61	58.54	48.52	59.53
		(.51)	(.02)	(-1.18)	(3.63)
Production	do.	175.42	181.18	154.93	196.01
		(0)	(-1.46)	(-1.05)	(2.05)
Market price	Dollars/ton	80.54	88.23	107.76	95.88
		(-2.92)	(-2.23)	(5.53)	(-20.75)

[1]The numbers in parentheses represent changes from the base value.

This scenario examines the response of the private and public sectors to a 5-percent annual growth in U.S. coarse grains exports between 1976 and 1981. Actual annual growth was about 10 percent.

Table 10 presents a comparison between the base and forecast solutions for 1977 through 1981. A number of general observations can be made:

- First, in 4 of the 5 years, the forecast export values would have been less than actual exports.
- Second, most of the effect of the changes in the first year would have been absorbed by variables representing the demand sector. Prices would have decreased 4.3 percent as the quantity of corn demanded for feed and total stocks increased by 1.7 percent and 3 percent, respectively. Nonrecourse loan and Government-owned Commodity Credit Corporation stocks would have accounted for 85 percent of the increase in total stocks. The same pattern of adjustment would also have been apparent for the other coarse grains sector where total stocks absorbed most of the adjustment. The restrictions on total coarse grains exports would have decreased corn and other coarse grains exports by 2.7 percent and 5 percent, respectively, despite the fall in price.
- Third, the change in the effective support price would have been negligible, indicating the low price elasticity of output (yields). We modeled our system so that output is the only explicit endogenous component within the agricultural sector through which the support price would be affected. The loan rate would have responded to decreased exports, but only minimally when compared with market price changes. The simulation results suggest that the Government would have increased the effective diversion payment rates in 1978, 1979, and 1980 in response to the low

Table 10—Impact of a 5-percent growth rate in U.S. coarse grains exports for 1977-81 for selected variables[1]

Commodity/variable	Unit	1977	1978	1979	1980	1981
Corn:						
Effective support price	Dollars per ton	65.65 (0)	72.21 (0)	76.36 (0)	81.20 (0)	86.82 (0)
Effective diversion payment	do.	0 (0)	5.03 (.39)	4.00 (.55)	3.40 (3.40)	0 (0)
Loan rate	do.	74.95 (0)	78.87 (-.29)	82.80 (-.80)	86.41 (-2.44)	90.76 (-3.84)
Area in Government programs	Million hectares	6.13 (0)	6.64 (.54)	5.80 (.77)	6.74 (6.74)	0 (0)
Area outside of Government programs	do.	25.50 (0)	24.79 (-.83)	25.85 (-1.21)	24.53 (-8.07)	32.32 (-.82)
Total area planted	do.	31.18 (0)	31.42 (-.30)	31.65 (-.44)	31.27 (-1.41)	32.32 (-.82)
Production	Million tons	165.40 (0)	173.70 (-1.90)	182.10 (-2.70)	148.90 (-9.10)	192.70 (-5.30)
Feed demand	do.	100.72 (1.67)	104.50 (2.37)	109.31 (6.29)	103.24 (5.30)	95.43 (-2.71)
Total stocks	do.	37.70 (1.10)	41.71 (1.63)	47.19 (5.25)	28.78 (3.22)	51.71 (-1.64)
Exports	do.	44.37 (-2.70)	50.67 (-3.97)	51.55 (-11.10)	50.04 (-8.01)	55.26 (4.09)
Market price	Dollars per ton	75.32 (-3.29)	82.24 (-5.76)	76.92 (-18.12)	98.67 (-14.96)	114.58 (7.58)
Other coarse grains:						
Area in Government programs	Million hectares	3.67 (0)	3.87 (.32)	3.53 (.48)	4.37 (4.37)	0 (0)
Area outside of Government programs	do.	15.36 (0)	13.52 (-.03)	14.05 (0)	15.20 (-2.22)	19.11 (1.10)
Total area planted	do.	19.03 (0)	17.36 (.30)	17.57 (.47)	19.57 (2.15)	19.11 (1.10)
Production	Million tons	40.32 (0)	37.86 (.55)	38.96 (.85)	38.44 (3.92)	43.19 (1.98)
Exports	do.	8.76 (-.46)	5.12 (-.42)	7.03 (-1.69)	11.47 (.05)	9.32 (1.89)
Total coarse grains exports	do.	53.13 (-3.16)	55.79 (-4.41)	58.58 (-12.79)	61.51 (-7.96)	(64.58) (5.98)

[1]The numbers in parentheses represent changes from base value.

prices, but the absolute magnitude of the increases would have been minimal.

- Fourth, with decreased market prices and increased effective diversion payment rates, the total area planted to corn under Government programs would have increased between 1978 and 1980. Concurrently, the area planted to corn outside Government programs would have declined. The net effect would have been a decline in the total area planted to corn between 1978 and 1981, which would have decreased corn output by 1.1 percent to 5.8 percent for this same period.

- Fifth, the lower price of corn would have increased the total area planted to other coarse grains by 1.8 percent to 12.3 percent between 1978 and 1981. Other coarse grains output would have increased during the same period by 1.6 percent to 11.4 percent. However, total coarse grains output between 1978 and 1981 would still have declined, although the difference would have been less than 1 percent for 1978 and 1979, and 2.7 percent and 1.4 percent for 1980 and 1981, respectively.

- Sixth, most of the changes leading to the sluggish growth in coarse grains exports would have been caused by the demand sector in the first 4 years. The market price, for instance, would have been lower than the base solution by 19.1 percent in 1979. Consequently, the quantity of corn demanded for food and feed purposes would have been 7 percent and 6.1 percent higher, respectively. Similarly, total corn stocks demanded would have been higher by 12.5 percent.

The model results suggest that slow export growth would have affected domestic consumers and producers. The Government response would have been confined largely to the loan rate and would have been minimal compared with other changes. Although the Government response to changes in the export market would have been minimal, the importance of the Government programs cannot be ignored during a period of slow export growth.

Loan Rate Moving Average

The loan rate is a price that the Government uses to determine the value of the nonrecourse loans for eligible farmers. Congress has set only minimal guidelines regarding the determination of the loan rate for corn. The Agriculture and Food Act of 1981, for example, allows the loan rate to drop no more than 10 percent in any given year if the market price in the previous year was less than 105 percent of the loan rate. The Secretary of Agriculture has considerable discretion to increase the loan rate.

Critics have argued that high loan rates established by the U.S. Government have led to escalating market prices, which reduce U.S. export sales. In view of this, some critics have suggested that a more clearly defined mechanism which allows considerably less discretion by the Secretary of Agriculture needs to be established that would link the loan rate to the market price. The objective of establishing such a link would be to ensure that loan rates lag rather than lead market prices. One proposal for such a link is to tie loan rates to a 3-year moving average of average price received by farmers during the previous 5 years. The high and low prices of the 5 preceding years would be eliminated before calculating the 3-year moving average.

$$MALT_t = \gamma[\sum_{i=1}^{5} (MP_{t-i}) - Max(MP_{t-i}) - MIN(MP_{t-i})]/3$$

where:

$MALT_t$ = moving average loan rate formula,

MP_{t-i} = average market price lagged i periods,

γ = coefficient established by the Government ($0 \leqslant \gamma \leqslant 1$), such as 80 percent.

The benefits of such an approach would be threefold. First, the loan rate would lag the market price, and loan rate escalation would be less likely. Second, this approach would create more certainty about the level of the loan rates because market prices of the past 5 years would be known with certainty. Less uncertainty would probably imply more efficiency in the decision-making process for coarse grains producers. Third, a precedent for using this type of approach has apparently been successful. The Agriculture and Food Act of 1981 authorizes the setting of soybean loan rates at 75 percent of the 5-year moving average of prices (with the high and low eliminated), but not lower than \$184.45 per ton[5]. Supporters say this approach has worked well for soybeans, noting that the CCC has historically acquired very few soybeans and that soybeans continue to move in the export market.

[5]The 1981 act further states that if the market price falls below 105 percent of the loan rate, the rate for the following year may be reduced up to 10 percent but may not drop below \$165.34 per ton.

The sixth scenario addresses three key issues. First, how differently would the system behave if the moving average approach to loan rates rather than the behavioral approach were used? Second, if the loan rate had been lower over the model solution period, would the market response have been any different than the behavioral approach? Third, if the system experienced a shock, would the repercussions with the moving average method be any different than with the behavioral approach?

Table 11 compares the solutions for the behavioral (current policy) and the moving average methods (γ at 100 percent) for production, total stocks, and the market price for corn. The two sets of solutions show very little difference, especially for production, where the largest discrepancy between the two sets would have been in 1966 when the solutions would have differed by 1.1 percent. Both solutions were nearly identical for total stocks demand. For the market price, the largest difference between the two sets of solutions was in 1980 when the moving average method forecasts a price that was 2.5 percent below the behavioral approach. Therefore, using a moving average loan formula with γ at 100 percent apparently does not affect the model results very much.

To evaluate how loan rates under the moving average method would affect market prices, we set the loan rate formula (γ) at 80 percent of the moving average price for the entire period beginning with 1965. We compared this solution with the base solution for which we set the loan rates at 100 percent of the moving average price. As expected, market prices would have declined for almost the entire period (table 12, fig. 2). But, a 20-percent decline in the loan rate caused only a 5-percent decline in the market price. There are two reasons for this very moderate decrease. First, the model structure allows an almost complete adjustment within the stocks structure when the loan rate changes. Hence, even though loan and CCC stocks decreased by a large amount, the corresponding increase in free stocks did not allow stocks to decline as much. Consequently, the market price decreased less. Second, we incorporated exogenous Farmer-Owned Reserve stocks into our system. As a result, the Farmer-Owned Reserve would not have responded to changes in the loan rate between 1977 and 1981, implying less of an effect on market price.

The third issue is market volatility. Although a moving average formula may be politically attractive, some effects of such an approach may prove unacceptable. In particular, if loan rates are so closely linked to only the market price, any abnormal disturbance to the market could lead to large fluctuations in the market price and hence could conceivably create more uncertainty than the current system of determining loan rates which provides considerable discretion to the Secretary of Agriculture. Therefore, whatever efficiency that a producer gains in periods of stability may be negated by increased problems of instability.

Table 11—Comparison of performance for the behavioral versus moving average method for setting the loan rates

Year	Production		Total stocks		Market price	
	Behavioral	Moving average	Behavioral	Moving average	Behavioral	Moving average
	Million tons				Dollars per ton	
1965	123.91	123.90	31.86	32.12	42.40	41.42
1966	127.02	125.64	32.53	31.39	40.76	41.58
1967	124.17	125.38	31.06	30.00	44.47	44.39
1968	133.71	133.56	33.11	31.56	40.29	40.20
1969	131.28	131.12	32.36	30.30	40.69	40.44
1970	104.43	104.06	23.70	20.91	54.41	54.06
1971	148.08	147.81	34.18	31.03	40.74	40.64
1972	149.81	149.70	29.66	25.92	49.79	49.28
1973	151.77	151.33	16.88	14.82	98.67	98.67
1974	141.53	141.54	15.60	14.50	116.23	117.79
1975	177.09	177.53	27.46	26.77	80.31	80.83
1976	164.54	164.79	28.09	28.36	79.95	80.92
1977	170.75	171.21	36.16	38.12	79.50	79.14
1978	175.89	175.69	41.62	42.58	81.98	82.89
1979	181.89	182.34	41.83	41.82	95.35	94.22
1980	158.16	157.67	25.76	25.34	114.33	111.41
1981	198.22	197.25	51.30	49.57	118.46	120.69

To examine this issue, we assumed a 1976 production shortfall proportional in magnitude to that of the first scenario (table 13). The overall nature of the effects on the demand and supply block variables were almost identical. The production shortfall would have increased prices in the first year. Conversely, the quantity of coarse grains demanded for food, feed, total stocks, and exports would have fallen. Total stocks and feed demand would have absorbed most of this shock. The effective support price would have fallen by 13.2 percent in the first year and continued declining for the next 4 years. Conversely, loan rates would have risen annually until 1981. The effects of the shock would have lasted longer with the moving average formula. The loan rate would have been 7.4 percent higher than the base solution value in 1981 for the moving average

Table 12—Market price and loan rates with the loan rate formula set at 100 percent and at 80 percent of the moving average

	Loan rate		Market price	
Year	100-percent moving average method	80-percent moving average method	100-percent moving average method	80-percent moving average mothod
	Dollars per ton			
1965	44.00	35.20	41.42	39.56
1966	44.00	35.20	41.58	39.05
1967	44.21	35.05	44.39	42.09
1968	44.87	35.50	40.20	36.63
1969	44.01	34.32	40.44	35.53
1970	42.43	32.57	54.06	50.78
1971	44.68	34.31	40.64	39.23
1972	43.88	33.30	49.28	45.58
1973	43.99	33.16	98.67	94.67
1974	47.84	36.24	117.79	128.20
1975	66.78	52.01	80.83	78.01
1976	77.14	60.34	80.92	93.45
1977	91.78	73.10	79.14	79.88
1978	91.78	73.10	82.89	80.16
1979	88.19	69.50	94.22	86.78
1980	88.19	69.50	111.41	105.20
1981	93.83	73.44	120.69	115.71

Figure 2

Market Prices With the Loan Rate Set at 100 Percent and at 80 Percent

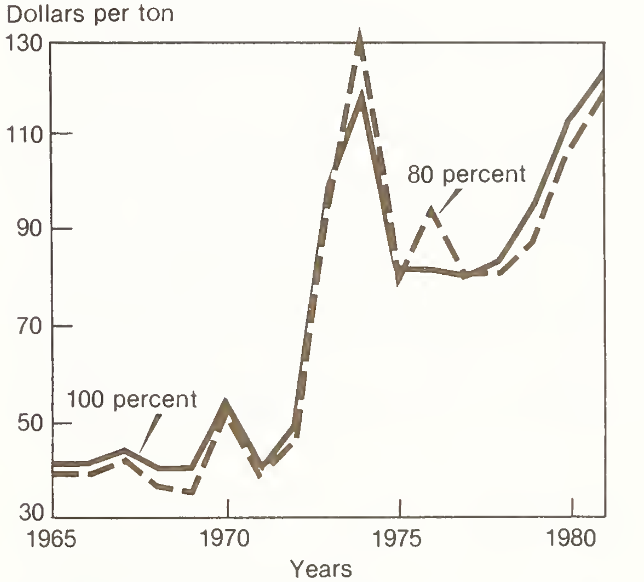


Table 13—Relative effects of a production shortfall for the behavioral versus the moving average loan rate formula

Item	1976	1977	1978	1979	1980	1981	Coefficient of variation of change
	Percent change from base solution						
Effective support price:							
Behavioral	0	-13.2	-4.9	-2.1	0	0	1.53
Moving average	0	-13.2	-5.0	-2.1	0	0	1.53
Loan rate:							
Behavioral	0	5.7	5.6	5.2	5.2	5.2	.49
Moving average	0	13.8	13.8	13.9	4.6	7.4	.86
Corn output:							
Behavioral	-33.1	13.5	1.2	0	0	0	1.68
Moving average	-33.6	13.5	1.6	0	0	0	1.67
Total corn stocks:							
Behavioral	-52.4	1.7	1.5	0	2.0	1.4	2.12
Moving average	63.7	-3.6	3.6	3.8	4.8	2.6	1.70
Corn exports:							
Behavioral	-17.4	14.0	1.1	0	0	0	1.49
Moving average	-17.3	14.0	3.4	0	1.2	0	1.28
Corn market price:							
Behavioral	64.8	0	-3.6	0	0	0	2.30
Moving average	65.6	1.4	2.3	1.4	-1.6	1.0	2.14

method compared with 5.2 percent for the behavioral approach. Similarly, the market price would still be adjusting to the shock in 1981 with the moving average approach, whereas it would have completely adjusted in 1978 with the behavioral approach. This same elongated response held true for all the corn variables except the effective support price and output supply variables for which the magnitudes of changes were marginally different.

The volatility of the system, as measured by the coefficient of variation of the absolute changes from the base, was lower or the same for all variables except the loan rate in the moving average approach. The moving average approach may have dampened annual oscillations for the entire system by increasing the volatility for the loan rate and by extending the variations over a longer length of time for the other variables. The tradeoffs between the two approaches is, therefore, higher loan rates and greater stability in the system versus lower loan rates but increased volatility. However, this conclusion of higher loan rates is valid only to the extent that two large and similar disturbances affect the system within a 5-year span. In this scenario, the increased loan rate was the result of production shortfalls in 1974 and 1976. If 1974 had been a normal year, the 1976 shock may not have resulted in higher loan rates. The Government could ensure lower loan rates by establishing a γ less than one.

Conclusions

Policy variables are not random variables unrelated to the system being modeled. A continuing and predictable interaction appears to exist between the private sector and those factors that shape and formulate agricultural policy. This interaction is clearly reflected in variables that explain the policy instruments. The support price, for instance, was explained by variables representing the previous year's yield (domestic production), the lagged value of the ratio of per capita farm to nonfarm income, the per hectare variable cost of production, and a lagged dependent variable representing the Government's past behavior. Each of these variables reflects either farmer or Government interests, and they are often in direct conflict with each other. The level of support price established is therefore a compromise between farm groups that lobby for higher supports and Government concerns that aim for lower support levels to minimize costs. This compromise, which is the outcome of legislative bargaining among various interest groups, represents the endogeny of policy in the model framework. This endogeny of policy is applicable not only to support prices, but also to loan rates and the effective diversion payment rate.

Large changes in domestic production can dramatically alter the environment in which policy decisions are made. A major production shortfall or bumper crop can affect Government policy decisions over a period of nearly 5 years, even though the entire supply-and-demand structure comes to an equilibrium within 3 years, because of the rigidities associated with policy decisions in the model. A large shock in the agricultural sector is normally necessary for changes in Government program provisions, and yet when a change does occur, the political ramifications and treasury outlays make it extremely difficult for the system to return to the original equilibrium levels in a short period of time.

The cost structures for producers participating in Government programs should be examined carefully. Given that increases in the production cost variable lead to relatively larger declines in participating area compared with nonparticipating area, some farmers participating in Government programs may be high-cost producers who are enrolling marginal land. Therefore, the current policies may be inadvertently encouraging misallocation of resources.

Changes in the levels of various policy instruments are less responsive to shifts from the export sector than to similar shifts from the domestic sector, reflecting the belief that the political costs of nonresponse under such circumstances are lower than similar changes arising from the domestic sector. However, Government programs remain important. Without these programs, the effects of changes in the export sector would be much more burdensome on producers, especially when the export market is sluggish.

In view of continued debate about the Farmer-Owned Reserve, any move to implement a ceiling on the Farmer-Owned Reserve should be taken cautiously. Although such a measure may solve the problems associated with the large accumulation of stocks, market prices may drop and deficiency payments, net treasury outlays, rise. Such a ceiling also may increase price instability because of lower total stocks available for Governmental price management purposes.

Implementing the moving average method to determine loan rates should provide definitive and timely information on the levels of loan rates and added shortrun stability. However, to prevent rapid loan rate escalations, the coefficient for the relationship between the

loan rate and the average market price should be set at a value less than 100 percent.

We based our recommendations and inferences on Government behavior on econometric estimates for the policy instruments which existed between 1960 and 1981. We implicitly assumed that the market structures which will affect future policy variables will be essentially the same as those which existed during the period for which the model was estimated. This assumption may not be valid. Market conditions can and do often change. Thus, the results may not accurately represent future Government behavior if the underlying model structure changes.

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Appendix: Conceptual Model for the Coarse Grains Sector

Corn

Supply block:

COAPP = f(ESPMPCL, EDPVCA, LMPSMPC, LMPBMPC, DUM7173)
COAPN = f(LMPCMPS, COASA, COAPP, LPIFPPI)
COAPT = COAPP + COAPN
COAHH = f(COAPT)
COSPR = f(COAHH, DUMPROD, WIN, PIFMPCL, TRE)
COASA = f(ESPMPCL, EDPVCA)

Demand block:

COUFE = f(RMPC, RMPM, RMPS, RPLP, AU, DUM7374)
COUHT = f(RMPC, RMPW, RPDY, POP)
COFST = f(FPCMPC, COLST, COCCC, COFOR, COTST(−1), COSPR)
COLST = f(MPCLRC, MPCLRC2, COFST, COLST(−1))
COCCC = COFST + COLST + COCCC + COFOR

Policy block:

COESP = f(COYHH(−1), DUMVCA, LPFYPDY, COESP(−1))
COEDP = f(COESP, COASA, VCA)
COLRC = f(INT, COCCC(−1), COFMP, COLRC(−1))

Other Coarse Grains

Supply block:

OGAPP = f(ESPMPCL, EDPVCA, DUM7173, LMPBMPS, LMPSMPC)
OGAPN = f(LMPSMPC, OGASA, OGAPP)
OGAPT = OGAPP + OGAPN
OGAHH = f(OGAPT)
OGSPR = f(OGAHH, DUMPROD, LPIFMPS, TRE)
OGASA = f(ESPMPCL, EDPVCA)

Demand block:

OGUFE = f(RMPC, RMPS, AU, RPLP)
OGUHT = f(RMPBA, RMPW, POP)
OGFST = f(FPCMPC, OGLST, OGCCC, OGFOR, OGTST(−1))
OGLST = f(MPCLRC, MPCLRC2, OGLST(−1))
OGCCC = f(MPCLRC, MPCLRC2, OGCCC(−1))
OGTST = OGFST + OGLST + OGCCC + OGFOR

All Coarse Grains

Trade block:

CGIMPT6 = f(RMPC, RMPM, ERSDRUSL, TRE)
COUXTOE = f(RMPC, COSPRME, TRE)
OGUXTOE = f(RMPC, RMPS, OGSPRME, TRE)
CGUXTUS = CGIMPT6 − COUXTOE − OGUXTOE
OGUXTUS = OGTST(−1) + OGSPR − OGUFE − OGUHT − OGTST
COUXTUS = CGUXTUS − COUXTUS

Equilibrium condition:

COSPR + COTST(−1) − COUFE − COUHT − COTST + OGSPR + OGTST(−1) − OGUFE − OGUHT − OGTST − CGUXTUS = 0

Variable Definitions

Endogenous variables:

The first two letters represent commodity codes:

CO = Corn
OG = Other coarse grains
CG = All coarse grains

The next three letters represent function codes:

APP = Area planted under Government programs
APN = Area planted outside of Government programs
ASA = Area set-aside under Government programs
APT = Total area planted
AHH = Total area harvested
SPR = Total output
CCC = Commodity Credit Corporation-owned stocks
LST = Nonrecourse loan stocks
FST = Farmer-held "free" stocks
TST = Total stocks
UTH = Nonfeed demand
UFE = Feed demand
MPA = Season average price received by farmers
IMP = Imports
UXT = Exports
EDP = Effective diversion payment rate
LRC = National average loan rate
YHH = Output per hectare
ESP = Effective support price

The last two letters represent country codes:

T6 = World
OE = Other competing exporters
US = United States

Exogenous variables (all variables refer to the United States unless specified):

BAMPA	= Average market price of barley received by farmers
SBMPA	= Average market price of soybeans received by farmers
SGMPA	= Average market price of sorghum received by farmers
WHMPA	= Average market price of wheat received by farmers
SBMPM	= 44-percent soybean meal price at Decatur, IL
SMMPAEX	= Rotterdam price of soybean meal, c.i.f.
PFY	= Per capita farm income
PDY	= Per capita disposable income
VCA	= Per hectare variable cost of producing corn
DUM7173	= Dummy variable for change in Government programs
	= 1 for 1971, 1972, 1973
	= 0 for all other years
DUMPROD	= Dummy variable denoting poor harvest years
	= 1 for 1970, 1974, 1980
	= 0 for all other years
DUMVCA	= Dummy variable for per hectare cost of providing corn
	= 0 for 1963-73
	= 1 for 1974-81
DUM7374	= Dummy variable for change in market structure
	= 1 for 1973 or 1974
	= 0 for all other years
AU	= Coarse grains consuming animal units
WIN	= Pasture index at the end of September in Iowa
TRE	= Trend variable representing years 1960-61
PLP	= Price index of livestock products
POP	= U.S. population
PPI	= An index of prices paid by farmers including wages, taxes, and interest rates
CPI	= Consumer Price Index
PIF	= An index of prices paid by farmers for fertilizers
INT	= Production Credit Association average cost of loans
COFMP	= April futures for corn to be delivered in December
COFOR	= Quantity of corn in Farmer-Owned Reserve
OGFOR	= Quantity of other coarse grains in Farmer-Owned Reserve
COSPRME	= Corn production in Argentina, Thailand, and South Africa
OGSPRME	= Other coarse grains output of Argentina, Australia, Thailand, and South Africa
ERSDRUSL	= Conversion ratio between the U.S. dollars and SDR lagged one period
EDPVCA	= COEDP/VCA
ESPMPCL	= COESP/COMPA(–1)
LMPSMPC	= SGMPA(–1)/COMPA(–1)
LMPBMPC	= BAMPA(–1)/COMPA(–1)
LMPCMPS	= COMPA(–1)/SBMPA(–1)
PIFMPCL	= PIF/COMPA(–1)
LPIFMPS	= PIF(–1)/SGMPA(–1)
RMPC	= COMPA/PPI
RMPM	= SBMPA/PPI
RMPW	= WHMPA/PPI
RMPS	= SGMPA/PPI
RPLP	= PLP/PPI
RPDY	= PDY/CPI
RPFY	= PFY/CPI
FPCMPC	= COFMP/COMPA
MPCLRC	= COMPA/COLRC
MPCLRC2	= (COMPA/COLRC)**2
LPFYPDY	= RPFY(–1)/RPDY(–1)
LPIFPPI	= PIF(–1)/PPI(–1)

☆ US Government Printing Office: 1986-621-066/02006

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